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Destruction of Hazardous and Mixed Wastes using Mediated Electrochemical Oxidation in a Ag(II)/HNO_3 Bench Scale System*

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ABSTRACT

Mediated Electrochemical Oxidation (MEO) is a promising technology for the destruction of organic containing wastes and the remediation of mixed wastes containing transuranic components. The combination of a powerful oxidant and an acid solution allows the conversion of nearly all organics, whether present in hazardous or in mixed waste, to carbon dioxide. Insoluble transuranics are dissolved in this process and may be recovered by separation and precipitation. The oxidant, or mediator, is a multivalent transition metal ion which is cleanly recycled in a number of charge transfer steps in an electrochemical cell.

The MEO technique offers several advantages which are inherent in the system. First, the oxidation/dissolution processes are accomplished at near ambient pressures and temperatures (30-70 ^{o}C). Second, all waste stream components and oxidation products (with the exception of evolved gases) are contained in an aqueous environment. This electrolyte acts as an accumulator for inorganics which were present in the original waste stream, and the large volume of electrolyte provides a thermal buffer for the energy released during oxidation of the organics. Third, the generation of secondary waste is minimal, as the process needs no additional reagents. Finally, the entire process can be shut down by simply turning off the power, affording a level of control unavailable in some other techniques.

Although the oxidation of organics and the dissolution of transuranics by higher valency metal ions has been known for some time, applying the MEO technology to waste treatment is a relatively recent development. Numerous groups, both in the United States and Europe, have made substantial progress in the last decade towards understanding the mechanistic pathways, kinetics, and engineering aspects of the process. At Lawrence Livermore National Laboratory, substantial contributions have been made to this knowledge base in these areas and others. Conceptual design and engineering development have been completed for a pilot plant-scale MEO system, and numerous data have been gathered on the efficacy of the process for a wide variety of anticipated waste components.

This presentation will review the data collected at LLNL for a bench-scale system based primarily on the use of a Ag(II) mediator in a nitric acid electrolyte; results from several other mediator/acid combinations will be included. Data obtained on the chemical, electrochemical, and engineering aspects will be presented. The topics of organics destruction, transuranic recovery, and some of the ancillary systems will be addressed, and areas requiring further study will be mentioned.

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